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[54] Title of the Invention: PHOSPHOR VAPOR DEPOSITION APPARATUS

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## CLAIMS

(57) [Claim(s)]
[Claim 1] It is fluorescent substance vacuum-evaporationo equipment which the steamy style from the aforementioned evaporation source characterized by to provide the following equips the aforementioned base material side with the specification-part material which regulates the crossing angle which carries out incidence, the aforementioned slit is more than the width of face of the base material of the conveyance direction of the aforementioned base material, and the direction which intersect perpendicularly, and the width of face of the direction where it intersects perpendicularly with the conveyance direction of the aforementioned base material carries out [ that the width of face in the conveyance direction of the aforementioned base material of the aforementioned slit is narrow in Evaporation source. Between the base materials and the aforementioned evaporation sources which move relatively to this evaporation source, it is a slit.

[Translation done.]

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[Industrial Application]
This invention relates to fluorescent substance vacuum evaporationo equipment and the fluorescent substance vacuum evaporationo equipment which enables creation of a fluorescent substance layer which covers a large area in more detail and has the thickness of simultaneously regularity.
[Description of the Prior Art]
The field of the invention has been cultivated [ extensive ranges, such as objects for a display, such as a fluorescent lamp, a fluorescent screen for X-ray photographs, or CRT, ] as examination is performed about a fluorescent substance for many years, and the foot of search of a fluorescent substance is extended and the elucidation of the luminescent mechanism of the fluorescent substance, a luminescence property, etc. progresses.
In use of these fluorescent substances, after fully distributing the fluorescent substance powder obtained by the general fluorescent substance synthesis method including a baking process in the solvent containing a binder, it applies on the base material of a glass tube and others. Then, this is dried, a solvent is removed and it is used for various uses by forming the fluorescent substance layer containing a binder.
Furthermore, an examination detailed about the extinction-of-phosphorescence nature, i.e., negatively-accelerated-phosphorescence nature and accelerated-phosphorescence nature, of fluorescent substance afterglow should do. Its attention is paid to accelerated-phosphorescence nature (the crystal fluorescent substance of high-persistence, fluorescence of this fluorescent substance a long wave if Nagamitsu is irradiated light storage phenomenon whose luminosity of afterglow energy is emitted from a fluorescent substance the bottom and increases rapidly) above all. The way which uses this accelerated-phosphorescence nature fluorescent substance as an intermediate-record medium of a radiation picture is cultivated, and the progress of the conformity to record media, such as an improvement to the rectangle-responsibility to improvement in accelerated-phosphorescence luminescence intensity and the excitation light of accelerated-phosphorescence luminescence or development of an accelerated-phosphorescence nature fluorescent substance, is sped up further.
A fluorescent substance is made to absorb the radiation which penetrated the photographic subject as this intermediate-record medium, and by exciting this fluorescent substance with light or heat energy after an appropriate time, this fluorescent substance makes the energy of radiation accumulated by the above-mentioned absorption emit as fluorescence, and detects and images it.
Specifically, the radiation image transformation method which made a visible ray or infrared radiation accelerated-phosphorescence excitation light using the accelerated-phosphorescence nature fluorescent substance is shown in U.S. JP,3,859,527,B and JP,55-12144,A. This method is what uses the radiation image transformation panel in which the accelerated-phosphorescence nature fluorescent substance layer was formed on the base material. Apply the radiation which penetrated the photographic subject in the accelerated-phosphorescence nature fluorescent substance layer of this radiation image transformation panel, store up the energy of radiation

corresponding to the degree of radioparency of each part of a photographic subject, and a latent image is formed. By scanning this accelerated-phosphorescence nature fluorescent substance layer with accelerated-phosphorescence excitation light after an appropriate time, the energy of radiation by which each part was accumulated is made to emit, it changes into light, and a picture is acquired by the lightwave signal by the strength of this light. A deer is carried out, and even if it reproduces as hard copy, you may reproduce this final picture on CRT.
However, the radiation ********** panel which generally has an accelerated-phosphorescence nature fluorescent substance layer Since the dispersion liquid containing a granular accelerated-phosphorescence nature fluorescent substance layer and an organic binder with a same particle size [ the / as the aforementioned general fluorescent substance ] of 1 micrometer - about 30 micrometers are applied on a base material (or protective layer), it dries and it is created low (generally -- 50% of filling factors) therefore, the pack density of an accelerated-phosphorescence nature fluorescent substance needed to thicken thickness of an accelerated-phosphorescence nature fluorescent substance layer, for making radiosensitivity high enough
On the other hand, the sharp nature at the time of the aforementioned radiation image transformation had the inclination for it to be higher as the thickness of the accelerated-phosphorescence nature fluorescent substance layer of a radiation image transformation panel is thin, therefore the lamination of an accelerated-phosphorescence nature fluorescent substance layer was required for it for improvement in sharp nature.
That is, the conventional radiation image transformation panel has been created by a certain amount of mutual sacrifice between the sensitivity which completely shows a reverse inclination to the thickness of an accelerated-phosphorescence nature fluorescent substance layer and the graininess of a picture, and the sharp nature of a picture.
Moreover, some meanses for improving the sharp nature of a radiation picture in such a situation have been thought out. For example, they are the method of mixing white fine particles into the accelerated-phosphorescence nature fluorescent substance layer of a radiation image transformation panel given in JP,55-146447,A, or the method of coloring so that the average reflectance in the accelerated-phosphorescence excitation wavelength field of the accelerated-phosphorescence nature fluorescent substance layer of a radiation image transformation panel given in JP,55-163500,A may become smaller than the average reflectance in the accelerated-phosphorescence luminescence wavelength field of the aforementioned accelerated-phosphorescence nature fluorescent substance layer. However, these methods were not able to be called desirable method, as a result of sensitivity's falling remarkably inevitably, if sharp nature is improved.
By the way, to form a fluorescent substance layer in recent years using the gaseous-phase depositing method with development of the thin film coating technology using the vacuum technology and the vacuum technology is tried, and, partly, it is already put in practical use. The X-ray image intensifier using the CsI:Na fluorescent substance layer as a fluorescent substance layer formed by this gaseous-phase depositing method, the thin film E.L. (electroluminescence) panel using the ZnS:Mn fluorescent substance layer, etc. are known. Moreover, these people have proposed the radiation image transformation panel which consists of an accelerated-phosphorescence nature fluorescent substance layer which does not contain a binder (binder) in JP,61-73100,A.
Unlike the conventional thing, since a fluorescent substance layer is formed in a vacuum, the amount of impurity mixing of the fluorescent substance layer formed by the these gaseous-phases depositing method decreases extremely, consequently its luminescence intensity is high, and moreover a fluorescent substance layer with little variation is obtained. Moreover, any matter other than fluorescent substances, such as a binder, is not contained, but since fluorescent substance pack density becomes about 100%, there are the features, like luminescence can use effectively. The sharp nature of a picture also came to be improved at the same time the directivity of the accelerated-phosphorescence excitation light in the inside of an accelerated-phosphorescence nature fluorescent substance layer and accelerated-phosphorescence luminescence improved and the sensitivity to the radiation of a radiation image transformation panel and the graininess of a picture have been improved, while the filling factor

of an accelerated-phosphorescence nature fluorescent substance layer improved remarkably, since an accelerated-phosphorescence nature fluorescent substance layer did not contain a binder especially in the case of the radiation image transformation panel.
The above "directive improvement" originates in the detailed columnar crystal formed in process of gaseous-phase deposition of an accelerated-phosphorescence nature fluorescent substance layer, and brings about a remarkable effect to the picture acquired. However, when these fluorescent substance layers were generally formed by the vacuum deposition, the sputtering method, etc. using the gaseous-phase depositing method, BARAKKI of the thickness of a fluorescent substance layer became a big problem. It is related with evaporation from a point evaporation source.

$$t / t_0 = \frac{1}{\left[1 + (x/h)^2\right]^{3/2}}$$

(t0 and t show the thickness in the position of Distance x here from the center of a base material side which only distance h separated from the evaporation source, and the center of a base material side, respectively.)
Since it comes out and the distribution of the thickness expressed is produced, it is h= 40cm of distance from an evaporation source, and if the size of a base material is set to 30cmx30cm, the thickness of the base material side periphery to the center of a base material side will become 82%, and will become thin no less than 18% to the center of a base material side, for example.
Conventionally, in order to make thickness uniform in the vacuum evaporationo to the base material of a large area, a large distance of an evaporation source and a base material is taken, or it has operated making a base material rotate etc.
[Problem(s) to be Solved by the Invention]
however -- operation of taking a large distance of these evaporation sources and a base material, or making a base material rotate etc. -- fluorescent substance stratification efficiency -- namely

$$\frac{\text{層の重量 (g)}}{\text{蒸発量 (g)}} \times 100 \quad (\%)$$

** -- it became remarkably bad and the vacuum tub big enough was needed to the base material

Moreover, the variation in thickness increased further as it was difficult to improve completely the fault that the variation in thickness becomes large by the base material periphery and vacuum evaporationo area became large.
The variation in the thickness of this fluorescent substance layer turned into variation in luminescence intensity, and when reproducing a picture, it not only brought about aggravation of repeatability, but it also influenced the acute nature and the graininess of a picture greatly. especially in the case of the radiation image transformation panel, since the panel of the size of 389mmx445mm was used, it was very difficult to continue all over a panel and to maintain at about 1 law the thickness of the accelerated-phosphorescence nature fluorescent substance layer formed by the conventional method
this invention is for canceling the above-mentioned trouble, and it aims at offering fluorescent substance vacuum evaporationo equipment with which the thickness of a fluorescent substance layer covers a large area, and serves as about 1 law Moreover, other purposes have good fluorescent substance stratification efficiency, and it is in offering the high fluorescent substance vacuum evaporationo equipment of productivity.
[Means for Solving the Problem]
In order to attain the above-mentioned purpose, this invention between an evaporation source, and the base material and the aforementioned evaporation source which move relatively to this evaporation source The steamy style from the aforementioned evaporation source which has a slit equips the aforementioned base material side with the specification-part material which regulates the crossing angle which carries out incidence. the aforementioned slit The width of face of the conveyance direction of the aforementioned base material and the direction which

intersects perpendicularly is more than the width of face of the base material of the conveyance direction of the aforementioned base material, and the direction which intersects perpendicularly, and width of face in the conveyance direction of the aforementioned base material of the aforementioned slit is characterized by being narrower in the center section than an edge.
Next, this invention is explained based on an accompanying drawing. a view 1 (a) -- a line -- it is explanatory drawing about movement of the relative position of an evaporation source and a base material, a posture, and a base material
this view -- setting -- 11 -- a line -- an evaporation source and 13 are base materials a line -- it pierces through the evaporation source 11 in the straight line a in the length direction this line -- evaporation sources 11 may be plural evaporation sources ****(ed) by the straight line a
The flat surface A containing the aforementioned straight line a makes Field C and the nodal line b of a base material 13, and crosses. This straight line a and nodal line b are parallel. Moreover, the flat surface B parallel to a nodal line b made the flat surface A and the crossing angle theta, and crossed, and the field C of a base material 13 is in contact with the flat surface B by Tangent c.
A deer can be carried out and a base material 13 can be moved to two sense (round trip) of an almost right-angled direction (arrow in drawing) at a nodal line b. In addition, a flat surface B may become flat-surface B' which touches the base material side C by the nodal line b.
Moreover, although the aforementioned crossing angle theta is defined by the streamline of a steamy style and the configuration of streamline specification-part material, and the position practical, its almost right-angled thing is desirable.
the aforementioned base material 13 -- like a view 1 (b) and (c) -- a line -- as opposed to the steamy style (a dashed line showing) 16 emitted from the evaporation source 11, if both-way movement in a nodal line b and a direction almost right-angled to b' is possible The flexible web (refer to (c)) which moves by the move mechanism 18 which consists of two or more rollers 15 for conveyance is sufficient even as the upright sheet-like object (refer to (b)) which moves according to a proper move mechanism (not shown) in a flat-surface top, and it is not restricted to the configuration, quality of the material, etc.
a view 1 (b) and (c) -- setting -- 12 -- a line -- it is arranged between an evaporation source 11 and a base material 13, it is the specification-part material which regulates the crossing angle theta of the steamy style 16 which carries out incidence to the 13th page of a base material, and in the gaseous-phase depositing method of an accelerated-phosphorescence nature fluorescent substance, this specification-part material 12 is formed in order to arrange the growth direction of the detailed columnar crystal which grows along the direction of a streamline of the steamy style of an accelerated-phosphorescence nature that is, by restricting the direction of the streamline which reaches the base material side of a steamy style, the growth direction of the aforementioned detailed columnar crystal can be arranged so that it may become the angle of about 1 law to a base material side Therefore, if the direction of incidence of the streamline of the steamy style which reaches a base material side is chosen, the growth direction of the aforementioned detailed columnar crystal can also be controlled, and it will become possible to form the most convenient accelerated-phosphorescence nature fluorescent substance in accelerated-phosphorescence excitation light irradiation and accelerated-phosphorescence luminescence condensing. In addition, when condensing by the condensing member which carries out single dimension irradiation of the accelerated-phosphorescence excitation light, and has a single dimension condensing field, as for the growth direction of the aforementioned detailed columnar crystal, it is desirable that it is right-angled to a base material side.
17 is the control means adjusted so that the amount of steams adhering to a base material 13 may not call at the position on a base material side but may become about 1 law, and these control means 17 are constituted so that regulation length d of the aforementioned specification-part material 12 can be suitably controlled by the amount distribution of steams, or they enable it to control the evaporation of an evaporation source 11 suitably like the 3rd illustration like the 2nd illustration
Namely, although it will become uniform if the thickness distribution of the fluorescent substance layer deposited on the 13th page of a base material has the fixed traverse speed in the move

direction [the direction of Y of a view 1 (b)] of a base material 13 the direction (a line -- the length direction [the direction of X of a view 1 (b)] of an evaporation source) which intersects perpendicularly in this move direction -- a line -- the evaporation from an evaporation source 11 not calling at a place, but, if it is fixed and both a center and a periphery have fixed regulation length d of the specification-part material 12 The amount of steams adhering to a base material 13 has the large density of a center section, and since the density of a periphery becomes small, the thickness of the periphery to the center of a base material side will become thin about 18% according to the density difference of the amount of steams. the aforementioned control means 17 -- regulation length d of the specification-part material 12 -- a center -- a periphery -- large -- carrying out -- the density difference of the amount of steams -- an amendment -- it makes it possible to make equivalent crystal-growth (deposition) speed on a base material, and to make mostly the thickness distribution of the center of a base material side, and a periphery into homogeneity by things moreover, a line -- it makes it possible to make uniform the thickness distribution of the center of a base material side, and a periphery like the above by controlling the evaporation from an evaporation source 11 so that periphery grade increases to center-section grade

Therefore, by control means 17, by regulation of the regulation length of the specification-part material 12, or evaporation, or regulation of the both ****, the thickness of the fluorescent substance layer on a base material side, can be controlled about all the directions, a large area is covered, and the fluorescent substance layer of uniform thickness can be formed.

When "the uniform thickness" said here sets the average of the maximum thickness of the fluorescent substance layer on a base material side, and the minimum thickness to t (micrometer), the distribution of the thickness in the whole vacuum evaporationo area says below t**5%t (micrometer) still more preferably below t**10%t (micrometer). In addition, of course, it is also possible to give the thickness distribution of hope if needed.

a view 2 -- as the specification-part material 12 -- many -- while arranging thin strip of several sheets 12a in the regulation direction in the shape of a roller screen possible [ displacement ], the case where each piece of-like [ ** ] 12a is connected with plunger 12b' of oil hydraulic cylinder 12b, respectively is shown This oil hydraulic cylinder 12b is coordinated with control means 17 through digital valve 12c. therefore, the control means 17 which received the information from the thickness monitor 37 which supervises an evaporation rate and ****** drive digital valve 12c, adjust the oil pressure (the amount of protrusions of plunger 12b') of each oil hydraulic cylinder 12b, and displace each piece of-like [ ** ] 12a like illustration in the regulation direction, and the amount of above adhering to a base material 13 does not call them at the position on a base material side, but it is making become about 1 law at the time of vacuum evaporationo

View 3 (a) - (e) shows the block diagram at the time of changing the kind and the evaporation method of the gaseous-phase depositing method. Moreover, although the thing which controls the power distribution consumed in resistance wire in a resistance heating vacuum deposition as control means 17, or the thing which controls a power distribution and scan speed of an electron beam in an electron-beam-heating vacuum deposition is shown, control of the evaporation distribution by electron beam control is more effective when a fluorescent substance is sublimability.

the unitary vacuum evaporationo which makes the fluorescent substance which evaporated the view 3 (a) by the resistance heating method from the evaporation source 21 a base material 22 deposition 23 -- this drawing (b) -- duality -- the duality which makes the fluorescent substance evaporated by the resistance heating method a base material 22 deposition 23 through the specification-part material 29 from the source 21 of vacuum evaporationo which carried out parallel installation -- vacuum evaporationo is shown, respectively this duality -- vacuum evaporationo is effective especially when obtaining the vacuum evaporationo film of the composition which the matter with which vapor pressure differs is evaporated simultaneously, and is made into the purpose

A view 3 (c) and (d) show electron-beam-heating vacuum evaporationo, and (c) arranges an electron gun 25 to the source 21 of vacuum evaporationo, and one at a line, as the source 21 of

vacuum evaporationo shows with an enlarged view. When a fluorescent substance is evaporated by the scan of the electron beam 24 emitted from it and deposition 23 is taken for a base material 22, (d) evaporates a fluorescent substance in the scan of the electron beam 24 emitted from it using pierced earring formula electron gun 25', and is the case where it carries out, deposition 23 at a base material 22.
A view 3 (e) is the case where the RF magnetron-sputtering method is used. The evaporation source 21 used here is constituted by the target 26 and the target electrode 27 as for which a magnetic field 28 combines and becomes so that may be formed in magnet 27a and electrode board (pole piece) 27b as shown in an enlarged view.
the above -- a line -- with an evaporation source, when two or more evaporation sources have been arranged to the line so that it may be represented with a view 3 (c) besides at the time of making the crucible itself into a line, it contains moreover, an evaporation source -- a line -- not only an evaporation source but a field-like evaporation source (a line -- the case where an evaporation source is put side by side is included) or a punctiform evaporation source (a line -- although the size of the length direction of an evaporation source is used in the 0.4 to 2.0 times as much range as base material width of face, the following [ the length of the minimum ] are said) is applicable But when an evaporation source is made into a field-like evaporation source, a base material 22 is installed above an evaporation source 21 in opposite like the 4th illustration (fixation). In case this evaporation source 21 is evaporated by the scan of the electron beam 24 emitted from the electron gun 25 a scan speed being controlled by control means 17, and, when an evaporation source is made into the punctiform evaporation source 21 like the 5th illustration , while the amount of steams does not call at the position on a base material side but it is made to become about 1 law Both-way movement of the base material 22 is carried out horizontally [ above this evaporation source 21 ]. between this evaporation source and a base material The steamy style from the aforementioned evaporation source forms the specification-part material 29 which regulates the crossing angle which carries out incidence in a base material side, and regulation is made possible so that the amount of steams adhering to a base material 22 may not call regulation length d of this specification-part material 29 at the position on a base material side but it may become almost fixed. In the case of this punctiform evaporation source, there is no regulation of evaporation.
This invention is effective especially when creating the radiation image transformation panel which consists of an accelerated-phosphorescence nature fluorescent substance layer which needs a large area.
The "radiation-like picture panel" said here is described as an example of the aforementioned intermediate-record medium, it does not reach for saying that the rate of the absorption of radiation and an optical conversion rate (it is called "radiosensitivity" including both) are high, but the graininess of a picture is good, and, moreover, to be what has high sharp nature is demanded. Radiosensitivity, graininess, and sharp nature are closely connected with the thickness of an accelerated-phosphorescence nature fluorescent substance layer, as mentioned above, radiosensitivity and graininess improve as thickness becomes thick, and since sharp nature falls, if it determines thickness, the radiation image transformation panel which has the radiosensitivity, the graininess, and sharp nature according to the thickness will be obtained. That is, the area of a radiation image transformation panel is large, and since the graininess of the picture acquired besides the variation in radiosensitivity and sharp nature will also be affected if a to some extent big difference arises in the thickness of a fluorescent substance layer while uniform fluorescent substance layer thickness is required, the diagnostic ability as a medical picture falls.
A deer is carried out, according to this invention, the unevenness of thickness can be canceled and a big effect is brought to improvement in a picture property.
Next, the vacuum evaporationo equipment and the vacuum evaporationo method of forming an accelerated-phosphorescence nature fluorescent substance layer in a base material side by the electron-beam-evaporation method which applied this invention are described based on a view 6.

A view 6 (a) is a schematic diagram of an example of electron-beam-heating vacuum

evaporationo equipment based on a view 3 (d), and a view 6 (b) is a plan showing the physical relationship of a base material and an evaporation source.
In this view, the electron beam with which a bell jar (vacuum tub) and 32 are emitted from a pierced earring formula electron gun, and 33 is emitted for 31 from a pierced earring formula electron gun, the crucible which puts in the accelerated-phosphorescence nature fluorescent substance (evaporation source) 34 with which 35 evaporates, the base material to which 311 should carry out the vacuum evaporationo of the accelerated-phosphorescence nature fluorescent substance, and 313 are the base material electrode holders united with the base material heating heater 312.
the length as the width of face of a base material 311 with the aforementioned crucible 35 same as shown in a view 6 (d) -- having -- an evaporation source 34 -- teaching -- a line -- an evaporation source is formed this line -- length a of an evaporation source 34 has about 0.4 to 2.0 good times to the width of face b of a base material 311, and its 0.7 to 1.4 times are more good namely, -- they are 0.4 or less times -- a thickness distribution -- it changes too much greatly and control becomes impossible -- it carries out and vacuum evaporationo efficiency becomes it bad that it is 2.0 or more
the aforementioned electron beam 33 -- a line -- incidence is carried out to an evaporation source 34, a raster scan is performed in the length direction, and it is made to evaporate by continuing in the length direction of an evaporation source In this case, an electron beam 33 can control now a power distribution or a scan speed by control means 17. That is, it controls so that the evaporation of periphery grade increases more than the center-section grade of an evaporation source 34, and the amount of steams adhering to a base material does not call at the position on a base material side, but it is made to become uniform.
or it makes it dissolve uniformly as an accelerated-phosphorescence nature fluorescent substance evaporated like the above -- a press and a hotpress -- fabricating -- a line -- it is taught to a crucible 35 as an evaporation source 34 Under the present circumstances, it is desirable to perform degasifying processing. Moreover, the aforementioned evaporation source 34 does not necessarily need to be an accelerated-phosphorescence nature fluorescent substance, and may mix with an accelerated-phosphorescence nature fluorescent substance raw material.
Moreover, you may dope an activator [activator] later to a parent [BASIC substance]. For example, after depositing only RbBr which is a parent, you may dope Tl which is an activator. Furthermore, since the evaporation source 34 by which uniform composition was carried out is evaporated in little ****** homogeneity, a crucible 35 can also be cooled using the pipe 36 for liquid cooling so that a local heating temperature up can be carried out.
The aforementioned base material 311 is made to counter the crucible 35 which taught the evaporation source 34, and is installed. According to the mean range of an accelerated-phosphorescence nature fluorescent substance, 10cm - 60cm is suitable for the interval in general. Moreover, a base material 311 may be made to be heated at the heating heater 312 by 50 degrees C - 350 degrees C. this base material 311 is moored to the wire 310 for conveyance of the base material electrode holder 313 interlocked with the motor (not shown) -- having -- a line -- along with a guide rail 39, it can move now in the right-angled direction to an evaporation source 34 38 is specification-part material about a steamy style.
In 314, a main valve and 315 show the auxiliary bulb and 316 shows the leak bulb. The leak bulb 316 is interlocked with the exhaust (not shown), and is used for appearance of the predetermined degree of vacuum in a bell jar 31, maintenance, and adjustment. A main valve 314 and the auxiliary bulb 315 eliminate the gas inside a bell jar 31 by the operation, and bring it to an about [ 10-4Torr-10-6Torr ] degree of vacuum. In addition, you may mix inert gas, such as an argon, in this case.
While incidence of the electron beam 33 is carried out to the part of an evaporation source 34 and it carries out little ****** from the pierced earring formula electron gun 32, moving a base material to right and left by constant speed now, vacuum evaporationo is advanced supervising an evaporation rate and vacuum evaporationo thickness by the thickness monitor 37. There are what detects mechanically the effect by the mho mentum of an evaporation flight particle as this

thickness monitor 37, a thing which measures the intensity of the spectrum of an evaporation flight particle. the time of supervising and controlling the thickness distribution on the base material side by this thickness monitor on-line -- this monitor -- like a view 6 (b) -- a line -- a large number are arranged along with an evaporation source, and each thickness monitor's detection signal is outputted to control means 17, and as it controls as the view 2 explained the regulation length of the aforementioned specification-part material 38, or the view 3 explained the evaporation of an evaporation source 34, it controls After an appropriate time, if it is detected by the thickness monitor that control means 17 did not call at the position on a base material side, but uniform vacuum evaporationo was performed (the fluorescent substance layer became predetermined thickness), it will stop vacuum evaporationo.
This thickness monitor's 37 surveillance and control of control means 17 are possible also at online or off-line.
In addition, two or more crucibles 35 which taught a mutually different evaporation source 34 are installed into a bell jar 31, vacuum evaporationo is carried out one by one, and the deposit which consists of two or more sorts of accelerated-phosphorescence nature fluorescent substances may be made to be obtained.
Moreover, the need may be accepted at the time of the aforementioned vacuum evaporationo, a vacuum evaporationo-ed object (a base material or protective layer) may be cooled or heated, and an accelerated-phosphorescence nature fluorescent substance layer may be heat-treated after a vacuum evaporationo end.
Furthermore, into the aforementioned bell jar 31, the gas of O2 and H2 grade may be introduced if needed, and reactant vacuum evaporationo may be performed.
Although the thickness of the accelerated-phosphorescence nature fluorescent substance layer obtained by the aforementioned vacuum deposition changes with kinds of the sensitivity and the accelerated-phosphorescence nature fluorescent substance to the radiation of the radiation image transformation panel made into the purpose etc., it is desirable to be chosen out of the range of 30 micrometers - 1000 micrometers. It is more preferably chosen out of the range of 40 micrometers - 800 micrometers. That is, since it is in the inclination for radiosensitivity to become bad since the rate of the absorption of radiation falls extremely when thickness of an accelerated-phosphorescence nature fluorescent substance layer is set to less than 30 micrometers, for about [ that the graininess of a picture deteriorates ] and an accelerated-phosphorescence nature fluorescent substance layer to tend to become transparent, for a lateral breadth to increase remarkably in the accelerated-phosphorescence nature fluorescent substance layer of accelerated-phosphorescence excitation light, and for the sharp nature of a picture to deteriorate, it is not desirable. It is because sharp nature will fall remarkably if 1000 micrometers is exceeded.
Moreover, in manufacture of a radiation image transformation panel, although the rate of sedimentation of an accelerated-phosphorescence nature fluorescent substance layer changes with purpose properties etc., 0.01-micrometer 100-micrometer a part for /- and thing [ a part for /] are desirable, 0.1-micrometer 10-micrometer a part for /- and thing [ a part for /] are desirable, and 0.1-micrometer 10-micrometer a part for /- and thing [ a part for /] are more desirable. That is, low preferably or conversely, when the rate of sedimentation is the following by 0.01-micrometer/, the productivity of a radiation image transformation panel is not difficultly desirable [ control of the rate of sedimentation ], when the rate of sedimentation exceeds a part for 100-micrometer/.
After the first light or high-energy radiation is irradiated, the above "an accelerated-phosphorescence nature fluorescent substance" is light-thermal, mechanical, chemical, or a fluorescent substance in which accelerated-phosphorescence luminescence is preferably shown by accelerated-phosphorescence excitation light 500nm or more from a practical field, although the fluorescent substance in which the first light or accelerated-phosphorescence luminescence corresponding to the exposure of high-energy radiation is shown is said by stimulus (accelerated-phosphorescence excitation) of electric **. As an accelerated-phosphorescence nature fluorescent substance used for the radiation image transformation panel of this invention, it is indicated by JP,48-80487,A, for example. BaSO4: The fluorescent substance expressed with

Ax, the fluorescent substance expressed with $MgSO_4$:Ax given in JP,48-80488,A, The fluorescent substance expressed with $SrSO_4$:Ax indicated by JP,48-80489,A, Na2 indicated by JP,51-29889,A -- the fluorescent substance which added at least one sort in Mn, Dy, and Tb in SO4, $CaSO_4$, and the $BaSO_4$ grade -- BeO, LiF and $MgSO_4$ which are indicated by JP,52-30487,A, and the fluorescent substance of $CaF_2$ grade, $Li_2B_4O_7$: indicated by JP,53-39277,A -- the fluorescent substance of Cu and Ag -- Fluorescent substances, such as $Li_2O$ and (B-2 O2) x:Cu indicated by JP,54-47883,A and $Li_2O$ and (B-2 O2) x:Cu, and Ag, SrS:Ce, Sm, SrS:Eu and Sm which are indicated by U.S. Pat. No. 3,859,527, $La_2O_2$ S:Eu, Sm and (Zn, Cd) S:Mn, and the fluorescent substance expressed with x are mentioned. Moreover, ZnS:Cu indicated by JP,55-12142,A, Pb fluorescent substance, the ulmin acid barium fluorescent substance by which a general formula is expressed with BaO-$xAl_2O_3$:Eu, and the alkaline-earth-metal silicate system fluorescent substance by which a general formula is expressed with MIIO-$xSiO_2$:A are mentioned.
Moreover, the alkaline-earth fluoridation halogenide fluorescent substance by which the general formula indicated by JP,55-12143,A is expressed with FX:Eu(Ba1-x-yMg x Cay) 2+, The fluorescent substance by which the general formula indicated by JP,55-12144,A is expressed with LnOX:xA, The fluorescent substance by which the general formula indicated by JP,55-12145,A is expressed with FX:yA (Ba1-xMIIx), The fluorescent substance by which the general formula indicated by JP,55-84389,A is expressed with BaFX:xCe and yA, The rare-earth-elements activation divalent-metal fluoro halide fluorescent substance by which the general formula indicated by JP,55-160078,A is expressed with MIIFX-xA:yLn, The fluorescent substance by which a general formula is expressed with ZnS:ACdS:A, S:A (Zn, Cd), X and Cds:A, and X, The fluorescent substance expressed with one of following general formula xM3(PO4) 2 and NX2:yAM3(PO4)2:yA(s) indicated by JP,59-38278,A, one of following general formula nReX3, mAX'2:xEunReX3, andmAX'2: indicated by JP,59-155487,A -- the fluorescent substance expressed with xEu and ySm -- The alkali halide fluorescent substance expressed with following general formula MIX-aMIIX'2 and bMIIIX"3:cA indicated by JP,61-72087,A, And the bismuth activation alkali halide fluorescent substance expressed with general formula MIX-xBi indicated by JP,61-228400,A is mentioned.
Especially an alkali halide fluorescent substance is [ that it is easy to make an accelerated-phosphorescence nature fluorescent substance layer form by methods, such as vacuum evaporationo and sputtering, ] desirable.
However, as long as the accelerated-phosphorescence nature fluorescent substance used for the radiation image transformation panel of this invention is a fluorescent substance in which accelerated-phosphorescence luminescence is shown when accelerated-phosphorescence excitation light is irradiated after not being restricted to the above-mentioned fluorescent substance and irradiating radiation, it may be what fluorescent substance.
Moreover, a radiation image transformation panel may be an accelerated-phosphorescence nature fluorescent substance group which consists of one or two accelerated-phosphorescence nature fluorescent substance layers or more including at least one kind of the above-mentioned accelerated-phosphorescence nature fluorescent substance. Moreover, although the accelerated-phosphorescence nature fluorescent substance contained in each accelerated-phosphorescence nature fluorescent substance layer may be the same, they may differ.
The metal sheet which various kinds of polymeric materials, glass, a metal, etc. are used as a base material used for a radiation image transformation panel, and has the enveloping layer of metal sheets, such as plastic film, such as a cellulose acetate film, polyester film, a polyethylene-terephthalate film, a polyamide film, a polyimide film, a triacetate film, and a polycarbonate film, an aluminium sheet, an iron sheet, and a copper sheet, or this metallic oxide is desirable.
The front face of these base materials may be a glide plane, and it is good also as a mat side in order to raise an adhesive property with an accelerated-phosphorescence nature fluorescent substance layer.
Moreover, the front face of a base material may be good also as a concavo-convex side 41, as shown in a view 7 (a), and as shown in this drawing (b), the structure which covered with the tile-like board 43 isolated on the front face of a base 42 is sufficient as it. Since a deer is carried

out, and in the case of a view 7 (a) an accelerated-phosphorescence nature fluorescent substance layer is subdivided by the concavo-convex side 41 as shown in a view 7 (c), the sharp nature of a picture improves much more. Since it deposits while an accelerated-phosphorescence nature fluorescent substance layer maintains the profile of the tile-like board 43 of a base material in the case of a view 7 (b), since an accelerated-phosphorescence nature fluorescent substance layer consists of pillar-shaped block 45 of the accelerated-phosphorescence nature fluorescent substance isolated by the crack 46 as shown in a view 7 (d), its sharp nature of a picture improves much more as a result.
Furthermore, these base materials may prepare an undercoating layer in the field in which an accelerated-phosphorescence nature fluorescent substance layer is prepared in order to raise an adhesive property with an accelerated-phosphorescence nature fluorescent substance layer.
Moreover, although these ******** change with quality of the materials to be used, generally they are 80 micrometers - 2000 micrometers, and are 80 micrometers - 1000 micrometers still more preferably from the point on handling.
In the radiation image transformation panel, the protective layer for protecting an accelerated-phosphorescence nature fluorescent substance layer physically or chemically may be prepared in the field of an opposite side with the field in which the base material of the aforementioned accelerated-phosphorescence nature fluorescent substance layer is generally prepared. Even if this protective layer pastes up the protective layer which could form even if it applied the application liquid for protective layers directly on the accelerated-phosphorescence nature fluorescent substance layer, or was formed separately beforehand on an accelerated-phosphorescence nature fluorescent substance layer, it can be formed. As a material of a protective layer, the usual charges of protective-layer material, such as cellulose acetate, a nitrocellulose, the poly methyl MECHIKURI rate, a polyvinyl butyral, a polyvinyl formal, a polycarbonate, polyester, a polyethylene terephthalate, polyethylene, a vinylidene chloride, and nylon, are used. Moreover, by the vacuum deposition, the sputtering method, etc., this protective layer may carry out the laminating of the mineral matters, such as SiC, SiO2, SiN, and aluminum 2O3, and may form them. Generally the thickness of these protective layers has 0.1 micrometers - desirable 2000 micrometers.
[Example]
Next, the example of this invention is explained in comparison with the example of comparison.
* Example of comparison It installed in the electron-beam-heating vacuum evaporationo equipment shown in the view 6 (a), using 389mmx445mmx1mm glass ceramics as a base material. RbBr which is the parent of the accelerated-phosphorescence nature fluorescent substance to evaporate -- a crucible 35 -- putting in -- a line -- an evaporation source 34 is obtained this line -- it is a= 48cm in length of an evaporation source 34 Moreover, the regulation length of the specification-part material 38 which regulates a steamy style was set to 9.5cm (fixed). At this time, the distance of a crucible 35 and a base material 311 was 43cm, and the distance of the specification-part material 38 and a crucible 35 was 38. In addition, the detail of the physical relationship of the aforementioned base material 311, a crucible 35, and the specification-part material 38 is as being shown in a view 6 (a) and (b).
Next, the inside of a bell jar 31 was exhausted, it held to the degree of vacuum of 2x10-6Torr, and heating maintenance of the base material was carried out at 100 degrees C.
Subsequently, the front face of an evaporation source 34 was made to scan and (for linear velocity to be regularity and for an amplitude to be 48cm) carry out incidence of the electron beam 33 in the direction (the length direction of an evaporation source) of a from an electron gun 32, carrying out both-way movement of the base material the speed for 50cm/, and the accelerated-phosphorescence nature fluorescent substance was evaporated continuously, and was deposited by 2-micrometer evaporation rate for /to the 370mmx435mm evaporation field on a base material side. The electron beam power at this time and the direction beam speed of a were fixed.
The deer was carried out, and vacuum evaporationo was advanced as while supervising an evaporation rate and vacuum evaporationo thickness with a thickness monitor, it went, vacuum evaporationo was terminated in the place where the thickness of an accelerated-

phosphorescence nature fluorescent substance layer became 300 micrometers, and the radiation image transformation panel was obtained.
Thus, the thickness distribution to the average thickness of the accelerated-phosphorescence nature fluorescent substance layer in the obtained radiation image transformation panel was **1% in the conveyance direction (the direction of Y of a view 1 (b)) of a base material, and in the direction of a of a base material, the thickness of both ends to the center of a base material side became 60%, and became thin no less than 40%. The fluorescent substance stratification efficiency of the thickness distribution was 4.3% about **20%. This cause is because the steamy style density of an evaporation source became high from the periphery in the center. This is for the focus of an electron beam to shift in the ends of an electron beam scan. In addition, this gap changes with the kinds of deflecting coil of an electron beam, and, in the case of a magnetic field formula coil, the toroidal coil has less gap than 4 **** coil.
* Example - (1)
They are the same conditions as the example of comparison except having amended the scan speed of an electron beam. Electron beam power was fixed, and the scan speed was amended so that the evaporation of ends evaporator grade might increase more than the central evaporator grade of an evaporation source by the following formulas on the basis of the thickness distribution obtained in the example of comparison.
V'(a) =(D (a) /** (a)) L-V (a) (the average and L of the fluorescent substance thickness in the position on the base material corresponding to V (a) in a dash (') corresponding to [ D / (a) / after amendment and ] the beam scan speed vector of the direction of a in V (a) and a bar are constants (=3).)
thus, the thickness distribution (it is **1% like [ in the conveyance direction of a base material ] the above-mentioned example of comparison) to the average thickness of the accelerated-phosphorescence nature fluorescent substance layer in the obtained radiation image transformation panel -- the direction of a of a base material -- setting -- **4.5% -- it is -- the whole surface of a radiation image transformation panel -- continuing -- about -- it was Mr. one Moreover, fluorescent substance stratification efficiency was 3.2%.
Consequently, the high radiation picture of the diagnostic ability excellent in graininess and sharp nature was able to be acquired by using this radiation image transformation panel for a diagnosis.

* Example - (2)
Except that convex circular [ of the opposite edge of specification-part material ] was carried out and 5.7cm and the maximum interval of both ends eased [ the minimum spacing of a center section ] passage of the evaporation style in both ends as 9.5cm, they are the same conditions as the example of comparison.
thus, the thickness distribution (it is **1% like [ in the conveyance direction of a base material ] the above-mentioned example of comparison) to the average thickness of the accelerated-phosphorescence nature fluorescent substance layer in the obtained radiation image transformation panel -- the direction of a of a base material -- setting -- **4.5% -- it is -- the whole surface of a radiation image transformation panel -- continuing -- about -- it was Mr. one Moreover, fluorescent substance stratification efficiency was 3.6%.
* Example - (3)
The opposite edge of specification-part material was made into the shape of convex radii, and 6.7cm and the maximum interval of both ends amended by L= 1 of the amendment formula which the minimum spacing of a center section eased passage of the evaporation style in both ends as 9.5cm, and showed to the example (1). They are the same conditions as the example of comparison except this.
thus, the thickness distribution (it is **1% like [ in the conveyance direction of a base material ] the above-mentioned example of comparison) to the average thickness of the accelerated-phosphorescence nature fluorescent substance layer in the obtained radiation image transformation panel -- the direction of a of a base material -- setting -- **4.4% -- it is -- the whole surface of a radiation image transformation panel -- continuing -- about -- it was Mr. one Moreover, fluorescent substance stratification efficiency was 3.6%.

* Example - (4)
** Use a 48cmx48cm field-like evaporation source.
** With no movement of specification-part material nothing and a base material.
** The scan speed of an electron beam is what made the example (1) two dimensions.
** They are the same conditions as the example of comparison except the above.
thus, the direction where the thickness distribution (it is **1% like [ in the conveyance direction of a base material ] the above-mentioned example of comparison) to the average thickness of the accelerated-phosphorescence nature fluorescent substance layer in the obtained radiation image transformation panel is perpendicular to the direction of a of a base material, and it -- **4.4% of each -- it is -- the whole surface of a radiation image transformation panel -- continuing -- about -- it was Mr. one Moreover, fluorescent substance stratification efficiency was 13.2%.
* Example - (5)
a line -- they are the same conditions as an example (1) except having outputted the detection signal of the thickness monitor which arranged along with the evaporation source to control means, and having controlled electron beam speed on-line
thus, the thickness distribution (it is **1% like [ in the conveyance direction of a base material ] the above-mentioned example of comparison) to the average thickness of the accelerated-phosphorescence nature fluorescent substance layer in the obtained radiation image transformation panel -- the direction of a of a base material -- setting -- **2% -- it is -- the whole surface of a radiation image transformation panel -- continuing -- about -- it was Mr. one Moreover, fluorescent substance stratification efficiency was 3.2%.
[Effect of the Invention]
Like the above, this invention between an evaporation source, and the base material and the aforementioned evaporation source which move relatively to this evaporation source The steamy style from the aforementioned evaporation source which has a slit equips the aforementioned base material side with the specification-part material which regulates the crossing angle which carries out incidence. the aforementioned slit The width of face of the conveyance direction of the aforementioned base material and the direction which intersects perpendicularly is more than the width of face of the base material of the conveyance direction of the aforementioned base material, and the direction which intersects perpendicularly. And by making an accelerated-phosphorescence nature fluorescent substance form into a detailed columnar crystal by regulating a steamy style, and regulating thickness, since it is characterized by the width of face in the conveyance direction of the aforementioned base material of the aforementioned slit being narrower in the center section than an edge Thickness can form an almost fixed layer over a large area, and the variation in the thickness in a base material periphery does so small the outstanding effect that improvement in thickness form success percentage and productivity can be aimed at, by the bird clapper.

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[Translation done.]

## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
view 1 (a) - (c) -- a line -- explanatory drawing showing the composition of an evaporation source, a base material, and specification-part material -- The plan of the specification-part material constituted so that a view 2 could control regulation length suitably by the amount distribution of steams, View 3 (a) Explanatory drawing in which - (e) shows the mode of the vacuum evaporationo method, the sketch-perspective diagram showing [ 4 ] the composition of a field-like evaporation source and a base material, The sketch-perspective diagram showing [ 5 ] the composition of a punctiform evaporation source, a base material, and specification-part material, a view 6 (a), and (b) are explanatory drawing of fluorescent substance vacuum evaporationo equipment, and explanatory drawing showing the example of the support surface suitable for view 7 (a) - (d) carrying out the vacuum evaporationo of the accelerated-phosphorescence nature fluorescent substance.
11, 21, and 34 .... a line -- an evaporation source
12, 29, 38 .... Specification-part material
12a, 12b .... Opposite edge
13 22,311 .... Base material
14 23 .... Deposition field
15 .... Roller for conveyance
16 .... Steamy style
17 .... Control means
18 .... Move mechanism
24 33 .... Electron beam
25, 25', 32 .... Electron gun
31 .... Bell jar (vacuum tub)
35 .... Crucible

[Translation done.]

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(56)参考文献　特公　昭60－30822（ＪＰ，Ｂ２）
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(54)【発明の名称】　蛍光体蒸着装置



(57)【特許請求の範囲】

【請求項１】蒸発源と、該蒸発源に対して相対的に移動する支持体と前記蒸発源との間に、スリットを有する前記蒸発源からの蒸気流が前記支持体面に入射する交角を規制する規制部材とを備え、前記スリットは、前記支持体の搬送方向と直交する方向の幅が、前記支持体の搬送方向と直交する方向の支持体の幅以上であり、かつ、前記スリットの前記支持体の搬送方向における幅が端部より中央部で狭くなっていることを特徴とする蛍光体蒸着装置。

【発明の詳細な説明】

〔産業上の利用分野〕

この発明は蛍光体蒸着装置、さらに詳しくは大面積に亘ってほぼ一定の層厚を有する蛍光体層の作成を可能とする蛍光体蒸着装置に関するものである。



〔従来の技術〕

蛍光体に関しては古くから検討が行われ、蛍光物質の探索の裾野を拡げ、また、その蛍光物質の発光機構、発光特性等の解明が進むにつれて蛍光灯、Ｘ線写真用蛍光スクリーン或いはCRT等のディスプレイ用等広汎な範囲に亘って利用分野が拓けてきた。

これら蛍光体の利用においては、焼成工程を含む一般的な蛍光体合成法によって得られた蛍光体粉末を、バインダを含む溶媒中に充分に分散させた後、ガラスチューブその他の支持体上に塗布する。その後、これを乾燥して溶媒を除去し、バインダを含む蛍光体層を形成することにより種々の用途に用いられている。

さらに、蛍光体残光の解尽性、即ち、消尽性と輝尽性について詳しい検討がなされ、就中、輝尽性（長残光性の結晶蛍光体に、該蛍光体の蛍光よりも長波長光を照射

すると蓄光した蛍光体からエネルギーが放出されて残光の明るさが急激に増す現象）に着目し、該輝尽性蛍光体を放射線画像の中間記録媒体として利用する途が拓かれ、さらに輝尽発光強度の向上、輝尽発光の励起光に対する矩形的応答性への改善、或いは輝尽性蛍光体の開発など記録媒体への適合の進度を速めている。

この中間記録媒体としては被写体を透過した放射線を蛍光体に吸収せしめ、しかる後、該蛍光体を例えば光又は熱エネルギーで励起することによりこの蛍光体が上記吸収により蓄積している放射線エネルギーを蛍光として放射させ、それを検出して画像化するものである。

具体的には、例えば米国特許3,859,527号及び特開昭55－12144号には輝尽性蛍光体を用いて可視光線又は赤外線を輝尽励起光とした放射線画像変換方法が示されている。この方法は支持体上に輝尽性蛍光体層を形成した放射線画像変換パネルを使用するもので、この放射線画像変換パネルの輝尽性蛍光体層に被写体を透過した放射線を当てて被写体各部の放射線透過度に対応する放射線エネルギーを蓄積させて潜像を形成し、しかる後、この輝尽性蛍光体層を輝尽励起光で走査することによって各部の蓄積された放射線エネルギーを放射させて光に変換し、この光の強弱による光信号により画像を得るものである。しかして、この最終的な画像はハードコピーとして再生しても、或いはCRT上に再生しても良い。

ところが、一般に輝尽性蛍光体層を有する放射接画像変換パネルは、前記一般蛍光体と同様の粒径１μｍ～30μｍ程度の粒状の輝尽性蛍光体層と有機結着剤を含む分散液を支持体（或いは保護層）上に塗布、乾燥して作成されるので、輝尽性蛍光体の充填密度が低く（大体充填率50%）、従って、放射線感度を充分に高くするには輝尽性蛍光体層の層厚を厚くする必要があった。

これに対し、前記放射線画像変換時の鮮鋭性は放射線画像変換パネルの輝尽性蛍光体層の層厚が薄ければ薄いほど高いという傾向があり、従って鮮鋭性の向上のためには輝尽性蛍光体層の薄層化が必要であった。

即ち、従来の放射線画像変換パネルは、輝尽性蛍光体層の層厚に対して全く逆の傾向を示す感度及び画像の粒状性と、画像の鮮鋭性との間にある程度の相互犠牲によって作成されてきた。

また、このような状況の中において、放射線画像の鮮＊＊鋭性を改善するための手段が幾つか案出されてきた。例えば、特開昭55－146447号記載の放射線画像変換パネルの輝尽性蛍光体層中に白色粉体を混入する方法、或いは特開昭55－163500号記載の放射線画像変換パネルの輝尽性蛍光体層の輝尽励起波長領域における平均反射率が前記輝尽性蛍光体層の輝尽発光波長領域における平均反射率よりも小さくなるように着色する方法等である。しかし、これらの方法は鮮鋭性を改良すると、必然的に感度が著しく低下してしまう結果、好ましい方法とは言えなかった。

ところで、近年、真空技術及び真空技術を利用した薄膜形成技術の発達と共に、気相堆積法を利用して蛍光体層を形成することが試みられ、一部では既に実用化されている。この気相堆積法により形成された蛍光体層としてはCsI:Na蛍光体層を用いたＸ線イメージ・インテンシファイアやZnS:Mn蛍光体層を用いた薄膜E.L.（エレクトロルミネセンス）パネル等が知られている。また、本出願人は特開昭61－73100号において、結着剤（バインダ）を含有しない輝尽性蛍光体層からなる放射線画像変換パネルを提案している。

これら気相堆積法により形成された蛍光体層は従来のものと異なり、真空中で蛍光体層が形成されるために不純物混入量が極めて少なくなり、その結果、発光強度が高く、しかも、バラツキの少ない蛍光体層が得られること、また、バインダなどの蛍光体以外の物質が含まれず、蛍光体充填密度がほぼ100%となるために発光が有効に利用できること、等の特徴がある。特に、放射線画像変換パネルの場合には輝尽性蛍光体層が結着剤を含有しないので輝尽性蛍光体層の充填率が著しく向上すると共に、輝尽性蛍光体層中での輝尽励起光及び輝尽発光の指向性が向上し、放射線画像変換パネルの放射線に対する感度及び画像の粒状性が改善されると同時に、画像の鮮鋭性も改善されるに至った。

前記「指向性の向上」は輝尽性蛍光体層の気相堆積の過程で形成される微細柱状結晶に由来するものであり、得られる画像に対して著しい効果をもたらす。しかし、一般にこれらの蛍光体層が気相堆積法を利用して蒸着法、スパッタリング法等により形成される場合には蛍光体層の層厚のバラッキが大きな問題となった。点蒸発源からの蒸発に関しては

$$t / t_0 = \frac{1}{[1 + (x / h)^2]^{3/2}}$$

（ここで$t_0$、$t$はそれぞれ蒸発源から距離$h$だけ離れた支持体面中央と支持体面中央から距離$x$の位置における層厚を示す。）

で表される層厚の分布を生じるので、例えば、蒸発源からの距離$h = 40$cmであり、支持体の大きさを30cm×30cmとすると、支持体面中央に対する支持体面周辺部の層厚は82%となり、支持体面中央に対して18%も薄くなってしまう。

従来、大面積の支持体への蒸着においては、層厚を均一にするために蒸発源と支持体との距離を大きくとったり、支持体を回転運動させるなどの操作を行ってきた。

〔発明が解決しようとする問題点〕

しかしながら、これら蒸発源と支持体との距離を大きくとったり、支持体を回転運動させる等の操作では蛍光

体層形成効率、即ち、

$$\frac{\text{層の重量}(g)}{\text{蒸発量}(g)}\times 100\ (\%)$$

が著しく悪くなったり、支持体に対して充分に大きな真空槽を必要とした。

また、支持体周辺部で層厚のバラツキが大きくなるという欠点を完全に改善することは困難であったし、蒸着面積が大きくなるにつれて層厚のバラツキが一層増大した。

この蛍光体層の層厚のバラツキは発光強度のバラツキとなり、画像を再現する際には再現性の悪化をもたらしたばかりでなく、画像の先鋭性や粒状性にも大きく影響した。特に、放射線画像変換パネルの場合は389mm×445mmといった大きさのパネルが使用されるため、従来の方法で形成される輝尽性蛍光体層の層厚をパネル全面に亘ってほぼ一定に保つことは至極困難であった。

この発明は上記の問題点を解消するためのもので、蛍光体層の層厚が大面積に亘ってほぼ一定となるような蛍光体蒸着装置を提供することを目的としている。また、他の目的は蛍光体層形成効率が良く、生産性の高い蛍光体蒸着装置を提供することにある。

〔問題点を解決するための手段〕

上記の目的を達成するため、この発明は、蒸発源と、該蒸発源に対して相対的に移動する支持体と前記蒸発源との間に、スリットを有する前記蒸発源からの蒸気流が前記支持体面に入射する交角を規制する規制部材とを備え、前記スリットは、前記支持体の搬送方向と直交する方向の幅が、前記支持体の搬送方向と直交する方向の支持体の幅以上であり、かつ、前記スリットの前記支持体の搬送方向における幅が端部より中央部で狭くなっていることを特徴としているものである。

次に、この発明を添付図面に基づき説明する。第1図（a）は線状蒸発源と支持体の関係位置、姿勢及び支持体の移動についての説明図である。

本図において、11は線状蒸発源、13は支持体である。線状蒸発源11は長さ方向に直線aで貫かれている。この線状蒸発源11は直線aによって串差しされた多元蒸発源であってもよい。

前記直線aを含む平面Aは支持体13の面Cと交線bを作って交わっている。この直線aと交線bは平行である。また、交線bに平行な平面Bは平面Aと交角θをなして交わり、支持体13の面Cは平面Bに接線cで接している。

しかして、支持体13は交線bにほぼ直角な方向（図中矢印）の２つの向き（往復）に移動可能である。なお、平面Bは交線bで支持体面Cに接する平面B′になってもよいものである。

また、前記交角θは蒸気流の流線及び流線規制部材の形状、位置によって実用的に定められるがほぼ直角であることが好ましい。

前記支持体13は第１図（b），（c）の如く線状蒸発源11から発した蒸気流（破線で示す）16に対し、即ち、交線b,b′にほぼ直角な方向に往復移動可能なものであれば、適宜の移動機構（図示せず）により平面上を移動する剛直なシート状物（（b）参照）でも、複数個の搬送用ローラ15よりなる移動機構18で移動する可撓性のウェブ（（c）参照）でも良く、また、その形状や材質などにも制限されない。

第１図（b），（c）において、12は線状蒸発源11と支持体13との間に配置され、支持体13面に入射する蒸気流16の交角θを規制する規制部材で、該規制部材12は輝尽性蛍光体の気相堆積法において、輝尽性蛍光体成分の蒸気流の流線方向に沿って成長する微細柱状結晶の成長方向を揃えるために設けられる。即ち、蒸気流の支持体面に到る流線の方向を制限することによって、前記微細柱状結晶の成長方向を支持体面に対してほぼ一定の角度となるように揃えることができる。従って、支持体面に到る蒸気流の流線の入射方向を選べば、前記微細柱状結晶の成長方向を制御することもできるし、輝尽励起光照射及び輝尽発光集光に最も好都合な輝尽性蛍光体を形成することが可能となる。なお、前記微細柱状結晶の成長方向は輝尽励起光を一次元照射し、一次元集光面を有する集光部材で集光する場合には支持体面に対し直角であることが好ましい。

17は支持体13に付着する蒸気量が支持体面上の位置によらずほぼ一定になるように調節する制御手段で、該制御手段17は第２図示の如く前記規制部材12の規制長さdを蒸気量分布により適宜コントロールできるように構成するか、或いは第３図示の如く蒸発源11の蒸発量を適宜コントロールできるようにしている。

即ち、支持体13面に堆積される蛍光体層の層厚分布は支持体13の移動方向〔第１図（b）のY方向〕での移動速度が一定であれば均一になるが、この移動方向に直交する方向（線状蒸発源の長さ方向〔第１図（b）のX方向〕）では線状蒸発源11からの蒸発量が場所によらず一定であり、かつ、規制部材12の規制長さdが中央と周辺部とが共に一定であれば、支持体13に付着する蒸気量は中央部の密度が大きく、周辺部の密度が小さくなるため、その蒸気量の密度差により支持体面の中央に対する周辺部の層厚が約18%も薄くなってしまう。前記制御手段17が規制部材12の規制長さdを中央より周辺部を大きくして蒸気量の密度差を補正することにより、支持体上での結晶の成長（堆積）速度を同等とし、支持体面中央と周辺部の層厚分布をほぼ均一にすることを可能としている。また、線状蒸発源11からの蒸発量を中央部位に対して周辺部位が多くなるようにコントロールすることにより支持体面中央と周辺部の層厚分布を上記同様に均一にすることを可能としている。

従って、制御手段17により規制部材12の規制長さ或い

は蒸発量の調節又はその双方同時の調節により、支持体面上の蛍光体層の層厚を全方向についてコントロール可能であり、大面積に亘って均一な層厚の蛍光体層を形成できる。

ここにいう「均一な層厚」とは支持体面上の蛍光体層の最大層厚と最小層厚の平均を t（μm）としたときに、蒸着面積全体における層厚の分布が t ±10% t（μm）以下、さらに好ましくは t ±５% t（μm）以下をいう。なお、必要に応じて希望の層厚分布をもたせることも可能であることは勿論である。

第２図は規制部材12として、多数枚の細条片12aを規制方向に変位可能にスダレ状に配設するとともに、各細状片12aをそれぞれ油圧シリンダ12bのプランジャー12b′に連結した場合を示している。この油圧シリンダ12bはデジタル弁12cを介して制御手段17に連繋されている。従って、蒸着時、蒸着速度や蒸着厚を監視する膜厚モニター37からの情報を受領した制御手段17はデジタル弁12cを駆動し、各油圧シリンダ12bの油圧（プランジャー12b′の突出量）を調節し、各細状片12aを規制方向に図示の如く変位し、支持体13に付着する上記量が支持体面上の位置によらずほぼ一定になるようにしている。

第３図（ａ）～（ｅ）は、気相堆積法の種類及び蒸発方法を変えた場合の構成図を示す。また、制御手段17としては、抵抗加熱蒸着法において抵抗線にて消費される電力分布をコントロールするもの、或いは電子ビーム加熱蒸着法において電子ビームの電力分布や走査速度をコントロールするものを示しているが、電子ビーム制御による蒸発量分布のコントロールは蛍光体が昇華性である場合においてより有効である。

第３図（ａ）は蒸発源21から抵抗加熱法により蒸発させた蛍光体を支持体22に堆積23させる一元蒸着を、同図（ｂ）は二元平行設置した蒸着源21から抵抗加熱法により蒸発させた蛍光体を規制部材29を通して支持体22に堆積23させる二元蒸着をそれぞれ示している。この二元蒸着は蒸気圧の異なる物質を同時に蒸発させ、目的とする組成の蒸着膜を得る場合に特に有効である。

第３図（ｃ）及び（ｄ）は電子ビーム加熱蒸着を示し、（ｃ）は蒸着源21が拡大図で示す如く蒸着源21と一体に電子銃25を線状に配置し、それより発した電子ビーム24の走査により蛍光体を蒸発させて支持体22に堆積23させた場合、（ｄ）はピアス式電子銃25′を用い、それより発した電子ビーム24の走査で蛍光体を蒸発させて支持体22に堆積23させた場合である。

第３図（ｅ）は高周波マグネトロンスパッタ法を用いた場合である。ここに用いた蒸発源21は拡大図の如くターゲット26と、マグネット27a及び電極板（ポール・ピース）27bを磁場28が形成されるように組み合せてなるターゲット電極27とにより構成されている。

上記線状蒸発源とは、坩堝自体を線状にした場合の他、第３図（ｃ）で代表される如く複数の蒸発源を線状に配置した場合も含む。また、蒸発源は線状蒸発源に限らず、面状蒸発源（線状蒸発源を併設した場合を含む）でも、点状蒸発源（線状蒸発源の長さ方向の寸法は支持体幅の0.4～2.0倍の範囲で使用されるが、その下限の長さ以下のものをいう）でも応用できる。尤も、蒸発源を面状蒸発源とした場合は第４図示の如く、蒸発源21の上方に支持体22を対向的に設置（固定）し、該蒸発源21を、電子銃25より発した電子ビーム24の走査により蒸発させる際に、走査速度を制御手段17により制御し、蒸気量が支持体面上の位置によらずほぼ一定になるようにする一方、第５図示の如く、蒸発源を点状蒸発源21とした場合は、該蒸発源21の上方において支持体22を水平方向に往復移動させ、該蒸発源と支持体との間に、前記蒸発源からの蒸気流が支持体面に入射する交角を規制する規制部材29を設け、該規制部材29の規制長さℓを支持体22に付着する蒸気量が支持体面上の位置によらずほぼ一定となるように調節可能にする。この点状蒸発源の場合は蒸発量の調節はない。

この発明は大面積を必要とする輝尽性蛍光体層からなる放射線画像変換パネルを作成する場合に特に有効である。

ここにいう「放射線状画像パネル」とは前記中間記録媒体の具体例として述べたものであって、放射線吸収率及び光変換率（両者を含めて「放射線感度」という）が高いことは言うに及ばず、画像の粒状性が良く、しかも、高鮮鋭性を有するものであることが要求される。放射線感度、粒状性及び鮮鋭性は前述した如く輝尽性蛍光体層の層厚と密接に関連しており、放射線感度と粒状性は層厚が厚くなるにつれて向上し、鮮鋭性は低下するから、層厚を決定すれば、その層厚に応じた放射線感度、粒状性及び鮮鋭性を有する放射線画像変換パネルが得られる。即ち、放射線画像変換パネルはその面積が大きく、均一な蛍光体層層厚が要求される反面、蛍光体層の層厚にある程度大きな差が生じれば放射線感度のバラツキの他に得られる画像の粒状性、鮮鋭性にも影響を及ぼすことから、医用画像としての診断能が低下する。

しかして、この発明によれば層厚の不均一さが解消でき、画像特性の向上に大きな効果をもたらすものである。

次に、この発明を適用した電子ビーム蒸着法により輝尽性蛍光体層を支持体面に形成する蒸着装置及び蒸着方法を第６図に基づいて述べる。

第６図（ａ）は第３図（ｄ）に基づく電子ビーム加熱蒸着装置の一例の概要図であり、第６図（ｂ）は支持体と蒸発源の位置関係を示す平面図である。

本図において、31はベルジャー（真空槽）、32はピアス式電子銃、33はピアス式電子銃より放射される電子ビーム、35は蒸発される輝尽性蛍光体（蒸発源）34を入れる坩堝、311は輝尽性蛍光体を蒸着すべき支持体、313は支持体加熱ヒータ312と一体化した支持体ホルダであ

る。

前記坩堝35は第６図（ｄ）の如く支持体311の幅と同じ長さを有し、蒸発源34を仕込んで線状蒸発源を形成する。この線状蒸発源34の長さａは支持体311の幅ｂに対して0.4〜2.0倍程度がよく、0.7〜1.4倍がより良い。即ち、0.4倍以下であると、膜厚分布大きく成り過ぎて制御ができなくなるし、2.0以上であると、蒸着効率が悪くなる。

前記電子ビーム33は線状蒸発源34に入射して長さ方向にラスタスキャンを行い、蒸発源の長さ方向に亘って蒸発を行わせる。この場合、電子ビーム33は制御手段17により電力分布或いは走査速度が制御できるようになっている。即ち、蒸発源34の中央部位より周辺部位の蒸発量が多くなるように制御し、支持体に付着する蒸気量が支持体面上の位置によらず均一になるようにしている。

上記の如く、蒸発させる輝尽性蛍光体としては均一に溶解させるか、プレス、ホットプレスによって成形して線状蒸発源34として坩堝35に仕込まれる。この際、脱ガス処理を行うことが好ましい。また、前記蒸発源34は必ずしも輝尽性蛍光体である必要はなく、輝尽性蛍光体原料を混和したものであってもよい。

また、母体〔basic substance〕に対して付活剤〔activator〕を後からドープしてもよい。例えば、母体であるRbBrのみを蒸着した後、付活剤であるTlをドープしてもよい。

さらに、坩堝35は均一組成された蒸発源34を少量宛組成均一に蒸発させるため局部加熱昇温できるように液冷用パイプ36を用いて冷却することもできるようになっている。

前記支持体311は蒸発源34を仕込んだ坩堝35に対向させて設置する。その間隔は輝尽性蛍光体の平均飛程に合わせて、概ね10cm〜60cmが適当である。また、支持体311は加熱ヒータ312によって50℃〜350℃に加熱されるようにしてもよい。この支持体311はモータ（図示せず）と連動した支持体ホルダ313の搬送用ワイヤ310に係留されて線状蒸発源34に対して直角方向にガイドレール39に沿って移動できるようになっている。38は蒸気流を規制部材である。

314はメインバルブ、315は補助バルブ、316はリークバルブを示している。リークバルブ316は排気装置（図示せず）と連動してベルジャー31内の所定真空度の現出と保持、調整のために用いられる。メインバルブ314と補助バルブ315はその操作でベルジャー31の内部の気体を排除し、$10^{-4}$Torr〜$10^{-6}$Torr程度の真空度にもたらす。なお、この際、アルゴン等の不活性ガスを混入してもよい。

今、支持体を左右に一定速度で移動させながらピアス式電子銃32から電子ビーム33を蒸発源34の局部に入射させ、少量宛蒸発させるとともに、膜厚モニター37によって蒸着速度、蒸着厚みを監視しながら蒸着を進める。この膜厚モニター37としては蒸発飛翔粒子のモーメンタムによる効果を機械的に検出するもの、蒸発飛翔粒子のスペクトルの強度を測定するもの等がある。この膜厚モニターによる支持体面上の膜厚分布をオンラインで監視して制御しようとするときは該モニターを第６図（ｂ）の如く線状蒸発源に沿って多数配列し、それぞれの膜厚モニターの検知信号を制御手段17に出力し、前記規制部材38の規制長さを第２図で説明した如く制御するか、或いは蒸発源34の蒸発量を第３図で説明したように制御する。しかる後、制御手段17は支持体面上の位置によらず均一な蒸着が行われたこと（蛍光体層が所定の厚みになったこと）が膜厚モニターにより検知されると蒸着を停止させる。



この膜厚モニター37の監視及び制御手段17の制御はオンラインでも、オフラインでも可能である。

なお、互いに異なる蒸発源34を仕込んだ複数の坩堝35をベルジャー31中に設置し、順次蒸着させ、複数種の輝尽性蛍光体から成る堆積層が得られるようにしてもよい。

また、前記蒸着時に必要に応じて被蒸着物（支持体あるいは保護層）を冷却或いは加熱してもよいし、蒸着終了後、輝尽性蛍光体層を加熱処理してもよい。

さらに、前記ベルジャー31中には必要に応じて$O_2$、$H_2$等のガスを導入して反応性蒸着を行ってもよい。

前記蒸着法によって得られる輝尽性蛍光体層の層厚は目的とする放射線画像変換パネルの放射線に対する感度、輝尽性蛍光体の種類等によって異なるが、30μm〜1000μmの範囲から選ばれることが好ましい。より好ましくは40μm〜800μmの範囲から選ばれる。即ち、輝尽性蛍光体層の層厚を30μm未満にした場合には放射線吸収率が極端に低下するから放射線感度が悪くなり、画像の粒状性が劣化するばかりか、輝尽性蛍光体層が透明となり易く、輝尽励起光の輝尽性蛍光体層中で横方向への広がりが著しく増大し、画像の鮮鋭性が劣化する傾向にあるので好ましくない。1000μmを越えると鮮鋭性が著しく低下するからである。

また、放射線画像変換パネルの製造において、輝尽性蛍光体層の堆積速度は目的特性等によって異なるが、0.01μm/分〜100μm/分であることが好ましく、0.1μm/分〜10μm/分であることが好ましく、0.1μm/分〜10μm/分であることがより好ましい。即ち、堆積速度が0.01μm/分未満の場合には放射線画像変換パネルの生産性が低く好ましくないし、逆に、堆積速度が100μm/分を越える場合には堆積速度のコントロールがむずかしく好ましくない。

前記「輝尽性蛍光体」とは、最初の光もしくは高エネルギー放射線が照射された後に、光的、熱的、機械的、化学的又は電気的等の刺激（輝尽励起）により、最初の光若しくは高エネルギー放射線の照射量に対応した輝尽発光を示す蛍光体を言うが、実用的な面から好ましくは

500nm以上の輝尽励起光によって輝尽発光を示す蛍光体である。この発明の放射線画像変換パネルに用いられる輝尽性蛍光体としては、例えば、特開昭48－80487号に記載されている。$BaSO_4$:Axで表される蛍光体、特開昭48－80488号記載の$MgSO_4$:Axで表される蛍光体、特開昭48－80489号に記載されている$SrSO_4$:Axで表される蛍光体、特開昭51－29889号に記載されている$Na_2SO_4$，$CaSO_4$及び$BaSO_4$等にMn,Dy及びTbのうち少なくとも１種を添加した蛍光体、特開昭52－30487号に記載されているBeO,LiF,$MgSO_4$及び$CaF_2$等の蛍光体、特開昭53－39277号に記載されている$Li_2B_4O_7$:Cu,Agの蛍光体、特開昭54－47883号に記載されている$Li_2O$・$(B_2O_2)x$:Cu及び$Li_2O$・$(B_2O_2)x$:Cu,Ag等の蛍光体、米国特許第3,859,527号に記載されているSrS:Ce,Sm、SrS:Eu,Sm、$La_2O_2S$:Eu,Sm及び（Zn,Cd）S:Mn,xで表される蛍光体が挙げられる。また、特開昭55－12142号に記載されているZnS:Cu,Pb蛍光体、一般式がBaO・$xAl_2O_3$:Euで表されるアルミン酸バリウム蛍光体、及び、一般式が$M^{II}O$・$xSiO_2$:Aで表されるアルカリ土類金属珪酸塩系蛍光体が挙げられる。

また、特開昭55－12143号に記載されている一般式が（$Ba_{1-x-y}Mg_xCa_y$）FX:$Eu^{2+}$で表されるアルカリ土類弗化ハロゲン化物蛍光体、特開昭55－12144号に記載されている一般式がLnOX:xAで表される蛍光体、特開昭55－12145号に記載されている一般式が（$Ba_{1-x}M^{II}_x$）FX:yAで表される蛍光体、特開昭55－84389号に記載されている一般式がBaFX:xCe,yAで表される蛍光体、特開昭55－160078号に記載されている一般式が$M^{II}FX$・xA:yLnで表される希土類元素付活二価金属フルオロハライド蛍光体、一般式がZnS:ACdS:A、（Zn、Cd）S:A,X及びCds:A,Xで表される蛍光体、特開昭59－38278号に記載されている下記いずれかの一般式

$xM_3(PO_4)_2$・$NX_2$:yA

$M_3(PO_4)_2$:yA

で表される蛍光体、特開昭59－155487号に記載されている下記いずれかの一般式

$nReX_3$・$mAX'_2$:xEu

$nReX_3$・$mAX'_2$:xEu,ySm

で表される蛍光体、特開昭61－72087号に記載されている下記一般式

$M^IX$・$aM^{II}X'_2$・$bM^{III}X''_3$:cA

で表されるアルカリハライド蛍光体、及び特開昭61－228400号に記載されている一般式$M^IX$・xBiで表されるビスマス付活アルカリハライド蛍光体等が挙げられる。

特に、アルカリハライド蛍光体は、蒸着、スパッタリング等の方法で輝尽性蛍光体層を形成させ易く好ましい。

しかし、この発明の放射線画像変換パネルに用いられる輝尽性蛍光体は、前述の蛍光体に限られるものではなく、放射線を照射した後、輝尽励起光を照射した場合に輝尽発光を示す蛍光体であればいかなる蛍光体であってもよい。



また、放射線画像変換パネルは前述の輝尽性蛍光体の少なくとも一種類を含む一つ若しくは二つ以上の輝尽性蛍光体層からなる輝尽性蛍光体層群であってもよい。また、それぞれの輝尽性蛍光体層に含まれる輝尽性蛍光体は同一であってもよいが異なっていてもよい。

放射線画像変換パネルに用いられる支持体としては各種の高分子材料、ガラス、金属等が用いられ、セルロースアセテートフィルム、ポリエステルフィルム、ポリエチレンテレフタレートフィルム、ポリアミドフィルム、ポリイミドフィルム、トリアセテートフィルム、ポリカーボネイトフィルム等のプラスチックフィルム、アルミニウムシート、鉄シート、銅シート等の金属シート或いは該金属酸化物の被覆層を有する金属シートが好ましい。

これら支持体の表面は滑面であってもよいし、輝尽性蛍光体層との接着性を向上させる目的でマット面としてもよい。

また、支持体の表面は第７図（ａ）に示す如く凹凸面41としてもよいし、同図（ｂ）の如く基部42の表面に隔絶されたタイル状板43を敷き詰めた構造でもよい。しかして、第７図（ａ）の場合には輝尽性蛍光体層が第７図（ｃ）の如く凹凸面41によって細分化されるので、画像の鮮鋭性が一段と向上する。第７図（ｂ）の場合には輝尽性蛍光体層が支持体のタイル状板43の輪郭を維持しながら堆積するので、結果的には輝尽性蛍光体層は第７図（ｄ）の如く亀裂46によって隔絶された輝尽性蛍光体の柱状ブロック45からなるため、画像の鮮鋭性が一段と向上する。

さらに、これら支持体は輝尽性蛍光体層との接着性を向上させる目的で輝尽性蛍光体層が設けられる面に下引層を設けてもよい。また、これら支持体厚は用いる材質等によって異なるが、一般的には80μｍ～2000μｍであり、取扱い上の点からさらに好ましくは80μｍ～1000μｍである。

放射線画像変換パネルにおいては、一般的に前記輝尽性蛍光体層の支持体が設けられる面とは反対側の面に、輝尽性蛍光体層を物理的に或いは化学的に保護するための保護層が設けられていてもよい。この保護層は保護層用塗布液を輝尽性蛍光体層上に直接塗布しても形成できるし、或いは予め別途形成した保護層を輝尽性蛍光体層上に接着しても形成できる。保護層の材料としては酢酸セルロース、ニトロセルロース、ポリメチルメチクリレート、ポリビニルブチラール、ポリビニルホルマール、ポリカーボネート、ポリエステル、ポリエチレンテレフタレート、ポリエチレン、塩化ビニリデン、ナイロン等の通常の保護層用材料が用いられる。また、この保護層は蒸着法、スパッタリング法等により、SiC,$SiO_2$,SiN,$Al_2O_3$などの無機物質を積層して形成してもよい。これらの保護層の層厚は一般には0.1μｍ～2000μｍが好まし

い。

〔実施例〕

次に、この発明の実施例を、比較例との比較において説明する。

＊比較例

支持体として389mm×445mm×1mmの結晶化ガラスを用い、第6図（a）に示した電子ビーム加熱蒸着装置に設置した。蒸発させる輝尽性蛍光体の母体であるRbBrを、坩堝35に入れ、線状蒸発源34を得る。この線状蒸発源34の長さa＝48cmである。また、蒸気流を規制する規制部材38の規制長さを9.5cm（一定）とした。このとき、坩堝35と支持体311との距離は43cmであり、規制部材38と坩堝35との距離は38であった。なお、前記支持体311、坩堝35及び規制部材38の位置関係の詳細は第6図（a），（b）に示す通りである。

次に、ベルジャー31内を排気し、$2\times10^{-5}$Torrの真空度に保持し、支持体を100℃に加熱保持した。

次いで、支持体を50cm/分の速度で往復移動させながら電子銃32から電子ビーム33を蒸発源34の表面にa方向（蒸発源の長さ方向）に走査（線速度が一定、振幅が48cm）して入射させ、輝尽性蛍光体を連続的に蒸発させて支持体面上の370mm×435mmの蒸発領域に2μm/分の蒸着速度で蒸着した。このときの電子ビーム電力と、a方向ビーム速度は一定であった。

しかして、膜厚モニタによって蒸着速度、蒸着厚みを監視しながらと蒸着を進めて行き、輝尽性蛍光体層の層厚が300μmとなった処で蒸着を終了させ、放射線画像変換パネルを得た。

このようにして得られた放射線画像変換パネルにおける輝尽性蛍光体層の平均層厚に対する層厚分布は支持体の搬送方向（第1図（b）のY方向）では、±1％であり、支持体のa方向において支持体面中央に対する両端部の層厚は60％となり、40％も薄くなった。層厚分布は約±20％、蛍光体層形成効率は4.3％であった。この原因は蒸発源の蒸気流密度が中央において周辺部より高くなったことによる。これは電子ビームの焦点が電子ビーム走査の両端においてズレるためである。なお、このズレは電子ビームの偏向コイルの種類により変化し、磁界式コイルの場合は4極子コイルよりトロイダルコイルの方がズレが少ない。

＊実施例－（1）

電子ビームの走査速度を補正した以外は比較例と同一条件である。電子ビーム電力を一定、走査速度を比較例で得られた層厚分布を基準として以下の式により蒸発源の中央蒸発部位より両端蒸発部位の蒸発量が多くなるように補正した。

$$V'_{(a)}=(D_{(a)}/\overline{D}_{(a)})^{L}\cdot V_{(a)}$$

（$V_{(a)}$はa方向のビーム走査速度ベクトル、ダッシュ（′）は補正後、$D_{(a)}$は$V_{(a)}$に対応する支持体上の位置における蛍光体層厚、バーは平均値、Lは定数（＝3）である。）

このようにして得られた放射線画像変換パネルにおける輝尽性蛍光体層の平均層厚に対する層厚分布（支持体の搬送方向では前述比較例と同様に±1％）は、支持体のa方向において±4.5％であり、放射線画像変換パネルの全面に亘ってほぼ一様であった。また、蛍光体層形成効率は3.2％であった。

この結果、この放射線画像変換パネルを診断に用いることにより、粒状性、鮮鋭性に優れた診断能の高い放射線画像を得ることができた。

＊実施例－（2）

規制部材の対向端縁を凸円弧状し、中央部の最小間隔が5.7cm、両端部の最大間隔が9.5cmとして両端部での蒸発流の通過を緩和した以外は比較例と同一条件である。

このようにして得られた放射線画像変換パネルに於ける輝尽性蛍光体層の平均層厚に対する層厚分布（支持体の搬送方向では前述比較例と同様に±1％）は、支持体のa方向において±4.5％であり、放射線画像変換パネルの全面に亘ってほぼ一様であった。また、蛍光体層形成効率は3.6％であった。

＊実施例－（3）

規制部材の対向端縁を凸円弧状にし、中央部の最小間隔が6.7cm、両端部の最大間隔が9.5cmとして両端部での蒸発流の通過を緩和し、実施例（1）に示した補正式のL＝1で補正した。これ以外は比較例と同一条件である。

このようにして得られた放射線画像変換パネルに於ける輝尽性蛍光体層の平均層厚に対する層厚分布（支持体の搬送方向では前述比較例と同様に±1％）は、支持体のa方向において±4.4％であり、放射線画像変換パネルの全面に亘ってほぼ一様であった。また、蛍光体層形成効率は3.6％であった。

＊実施例－（4）

①48cm×48cmの面状蒸発源を用いる。

②規制部材なし、支持体の移動なし。

③電子ビームの走査速度は実施例（1）を二次元にしたもの。

④上記以外は比較例と同一条件。

このようにして得られた放射線画像変換パネルに於ける輝尽性蛍光体層の平均層厚に対する層厚分布（支持体の搬送方向では前述比較例と同様に±1％）は、支持体のa方向及びそれに垂直な方向で各々±4.4％であり、放射線画像変換パネルの全面に亘ってほぼ一様であった。また、蛍光体層形成効率は13.2％であった。

＊実施例－（5）

線状蒸発源に沿って配列した膜厚モニターの検知信号を制御手段に出力し、電子ビーム速度をオンラインで制御した以外は実施例（1）と同一条件である。

このようにして得られた放射線画像変換パネルに於ける輝尽性蛍光体層の平均層厚に対する層厚分布（支持体

の搬送方向では前述比較例と同様に±１％）は、支持体のａ方向において±２％であり、放射線画像変換パネルの全面に亘ってほぼ一様であった。また、蛍光体層形成効率は3.2%であった。

〔発明の効果〕

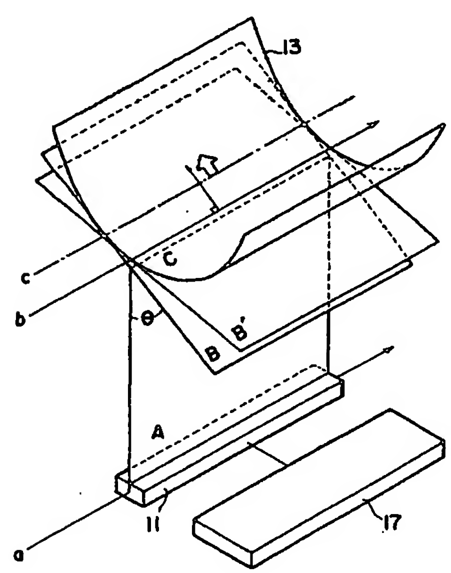
以上の如く、この発明は、蒸発源と、該蒸発源に対して相対的に移動する支持体と前記蒸発源との間に、スリットを有する前記蒸発源からの蒸気流が前記支持体面に入射する交角を規制する規制部材とを備え、前記スリットは、前記支持体の搬送方向と直交する方向の幅が、前記支持体の搬送方向と直交する方向の支持体の幅以上であり、かつ、前記スリットの前記支持体の搬送方向における幅が端部より中央部で狭くなっていることを特徴としているから、蒸気流を規制することで輝尽性蛍光体を微細柱状結晶化させ、かつ膜厚を規制することにより、大面積にわたって層厚がほぼ一定な層を形成することができ、支持体周辺部での層厚のバラツキが小さくなることにより、膜厚形成功率、生産性の向上を図ることができるという優れた効果を奏するものである。

【図面の簡単な説明】

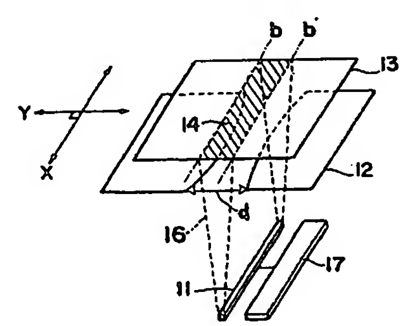
第１図（ａ）～（ｃ）は線状蒸発源と支持体と規制部材の構成を示す説明図、第２図は規制長さを蒸気量分布に＊より適宜コントロールできるように構成した規制部材の平面図、第３図（ａ）～（ｅ）は蒸着方法の態様を示す説明図、第４図は面状蒸発源と支持体の構成を示す略示的斜視図、第５図は点状蒸発源と支持体と規制部材の構成を示す略示的斜視図、第６図（ａ）、（ｂ）は蛍光体蒸着装置の説明図、第７図（ａ）～（ｄ）は輝尽性蛍光体を蒸着するのに適した支持体表面の例を示す説明図である。

11,21,34……線状蒸発源
12,29,38……規制部材
12a,12b……対向端縁
13,22,311……支持体
14,23……堆積領域
15……搬送用ローラ
16……蒸気流
17……制御手段
18……移動機構
24,33……電子ビーム
25,25′,32……電子銃
31……ベルジャー（真空槽）
35……坩堝

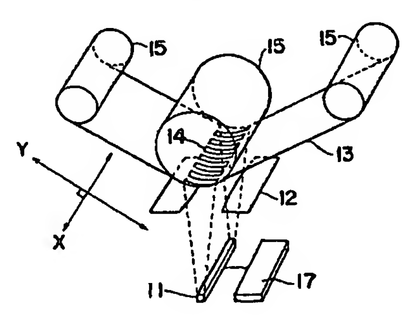
【第１図（ａ）】



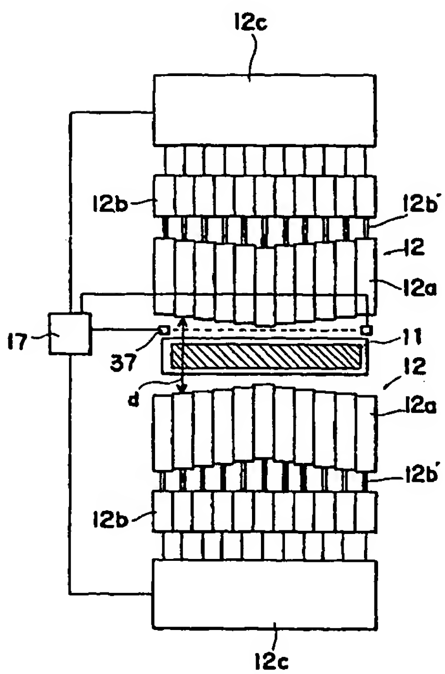

【第１図（ｂ）】



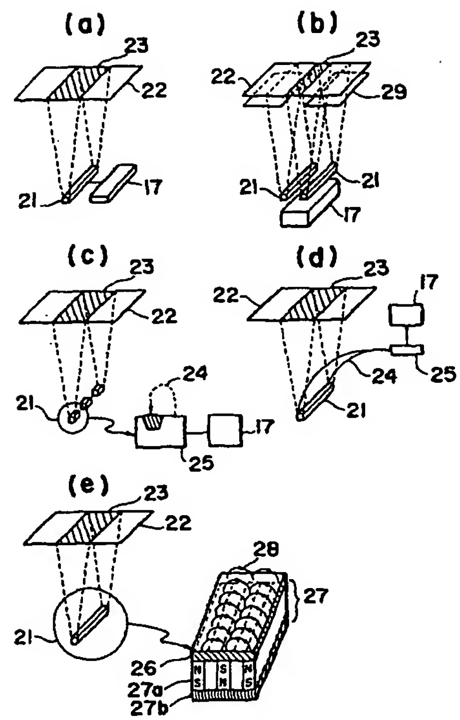

【第１図（ｃ）】



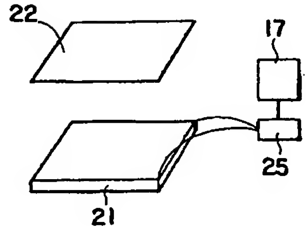
【第２図】



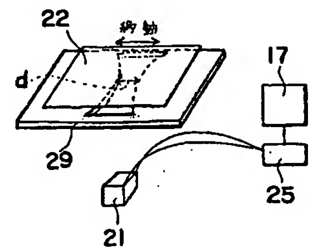

【第３図】



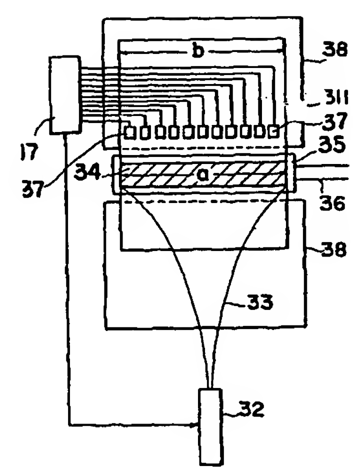

【第４図】



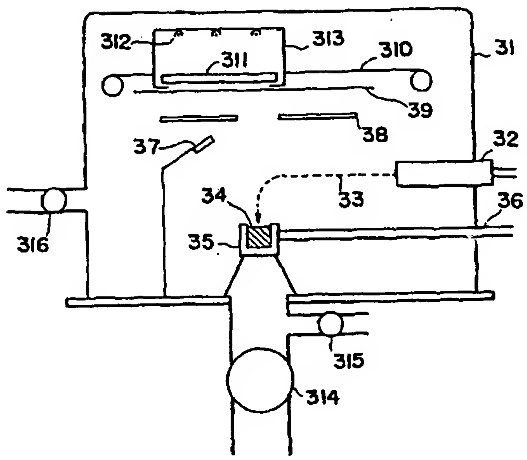

【第５図】




【第６図（ｂ）】



【第６図（ａ）】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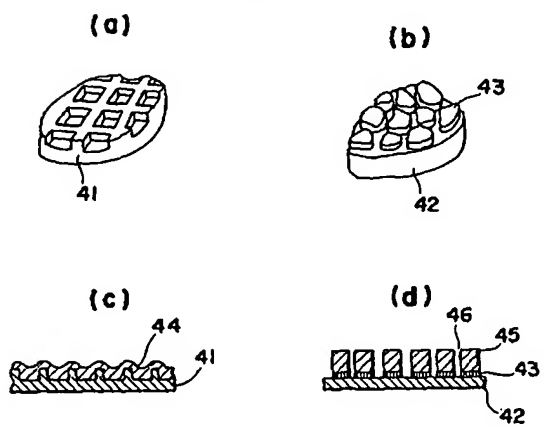
【第７図】


(a)
(b)
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(c)
(d)
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